

Claims

- [c1] 1. A method of locating a source of a localized elevation on a substrate, comprising the steps of:
 - (a) measuring a first surface of a plurality of substrates placed separately on a chuck to obtain topography measurements;
 - (b) detecting the presence of a localized elevation in a field on the first surface of the substrates; and
 - (c) determining whether the source results from the chuck.
- [c2] 2. The method of claim 1, wherein the topography measurements include height, pitch, and roll measurements.
- [c3] 3. The method of claim 2, wherein the step (b) further comprises comparing said z, pitch, and roll measurements to pre-defined limits, wherein the localized elevation is detected when any one of said z, pitch, and roll measurements exceeds said pre-defined limit.
- [c4] 4. The method of claim 3, wherein said pre-defined limits comprise z equal to about 0.15 um and pitch equal to about 80 microradians.

- [c5] 5. The method of claim 2, wherein the step (b) comprises detecting the presence of the localized elevation on at least three substrates.
- [c6] 6. The method of claim 5, wherein the step (c) comprises:
 - calculating a best linear regression fit line for each pair of pitch-z, roll-pitch and z-roll measurements in the field;
 - calculating R^2 for each of the calculated best linear regression fit lines; and
 - comparing R^2 to a threshold value.
- [c7] 7. The method of claim 6, wherein the threshold value is 0.95.
- [c8] 8. The method of claim 6, wherein when R^2 is greater than the threshold value, the source of the localized elevation is related to the chuck.
- [c9] 9. The method of claim 8, wherein the source of the localized elevation comprises a foreign material particulate attached to the chuck.
- [c10] 10. The method of claim 9 further comprising the step of cleaning the chuck.
- [c11] 11. The method of claim 6, wherein when R^2 is less than

the threshold value, the source of the localized elevation is related to at least one of said substrates.

- [c12] 12. The method of claim 11, wherein the source of the localized elevation comprises damage on a second surface of said at least one of said substrates.
- [c13] 13. The method of claim 12, wherein the damage comprises a scratch.
- [c14] 14. The method of claim 11, wherein the source of the localized elevation comprises a foreign material particulate attached to the second surface of said at least one of said substrates.
- [c15] 15. The method of claim 14 further comprising the step of cleaning said at least one of said substrates.
- [c16] 16. The method of claim 1, wherein when the presence of the localized elevation is detected, issuing an alarm.
- [c17] 17. The method of claim 16, wherein when substrates are being processed in a tool, preventing processing of subsequent substrates until corrective action is taken to eliminate the source of the localized elevation.
- [c18] 18. The method of claim 1, wherein when the source of the localized elevation is related to the chuck, providing

the X/Y coordinates of the source of the localized elevation so that corrective action on the chuck can be directed to a corresponding location on the chuck.

- [c19] 19. The method of claim 1, wherein X/Y coordinates of the source of the localized elevation are correlated to a step array map to determine which chips are affected by the localized elevation.
- [c20] 20. The method of claim 19, wherein the affected chips are further correlated to a known yield distribution by substrate region.
- [c21] 21. The method of claim 1 further comprising setting a limit for a maximum number of localized elevations that are detected so that a corrective action can be taken to eliminate the source of the localized elevation.
- [c22] 22. The method of claim 21, wherein the corrective action comprises the steps of stopping processing, cleaning the chuck to remove particulate matter and resuming processing; or stopping production, removing wafers from the tool to determine the source of the localized elevation and starting production with a new lot of wafers.
- [c23] 23. The method of claim 1 further comprising the step of patterning an image on said first surface using a photolithographic tool.

- [c24] 24. The method of claim 23, wherein the topography measurements are obtained from focus parameter data from the photolithographic tool.
- [c25] 25. The method of claim 23, wherein locating the source of the localized elevation is independent of imaging level or underlying optical qualities.
- [c26] 26. The method of claim 23, wherein each substrate is analyzed to detect the presence of a localized elevation.
- [c27] 27. A computer-readable program product for causing a computer to detect and characterize a defect on a surface of a first wafer, comprising:
 - a first program code means embodied in a computer useable medium for causing the computer to carry out a first set of measurements on a given surface of said first wafer placed on a chuck prior to carrying out an operation on said given surface;
 - a second program code means embodied in a computer useable medium for causing the computer to carry out a second set of measurements on said given surface of said first wafer while carrying out said operation on said given surface;
 - a third program code means embodied in a computer useable medium for causing the computer to deter-

mine a difference between said first set of measurements and said second set of measurements; a fourth program code means embodied in a computer useable medium for causing the computer to carry out said first set of measurements, said second set of measurements and said difference measurement on a second wafer placed on the chuck; a fifth program code means embodied in a computer useable medium for causing the computer to carry out said first set of measurements, said second set of measurements and said difference measurement on a third wafer placed on the chuck; and a sixth program code means embodied in a computer useable medium for causing the computer to compare said measurements from said first wafer, said second wafer, and said third wafer to determine whether a defect results from said chuck.

[c28] 28. A program storage device readable by a machine, tangibly embodying a program of instructions executable by a machine to perform a method of locating a source of a localized elevation on a substrate, comprising the steps of:

- (a) measuring a first surface of a plurality of substrates placed separately on a chuck to obtain topography measurements;

(b) detecting the presence of a localized elevation in a field on the first surface of the substrates; and
(c) determining whether the source results from the chuck.

[c29] 29. The method of claim 28, wherein the topography measurements include height, pitch, and roll measurements.

[c30] 30. The method of claim 29, wherein the step (b) further comprises comparing said z, pitch, and roll measurements to pre-defined limits, wherein the localized elevation is detected when any one of said z, pitch, and roll measurements exceeds said pre-defined limit.

[c31] 31. The method of claim 29, wherein the step (b) comprises detecting the presence of the localized elevation on at least three substrates.

[c32] 32. The method of claim 31, wherein the step (c) comprises:
calculating a best linear regression fit line for each pair of pitch-z, roll-pitch and z-roll measurements in the field;
calculating R^2 for each of the calculated best linear regression fit lines; and
comparing R^2 to a threshold value.

- [c33] 33. The method of claim 32, wherein when R^2 is greater than the threshold value, the source of the localized elevation is related to the chuck.
- [c34] 34. The method of claim 32, wherein when R^2 is less than the threshold value, the source of the localized elevation is unique to said at least one of said plurality of the substrates.